

U. S. DEPARTMENT OF AGRICULTURE - FOREST SERVICE
PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION
Berkeley 1, California

An Appraisal of Fire Injury to Coniferous Plantations
on the San Dimas Experimental Forest, July 1960

On July 29, Willis W. Wagener of the Division of Forest Disease Research and Ralph C. Hall of the Division of Forest Insect Research made a joint appraisal of the coniferous plantations on the San Dimas Experimental Forest. Their purpose was (1) to survey the damage caused by the fire of July 21-23, which covered practically all of the experimental area; and (2) to determine what steps might be taken to preserve the residual stand.

The coniferous plantings on the Experimental Forest, mostly made by Los Angeles County Forestry Department, total about 136 acres and are located in eight different areas. They are among the oldest plantations in the State, the oldest one being the Flintham Memorial Forest established 41 years ago. The average plantation is 31-years old. The principal tree species in the plantations is Pinus coulteri. The second most abundant species is P. attenuata. Other miscellaneous coniferous species present include P. radiata, P. canariensis, P. muricata, P. pinea, P. torreyana, P. monophylla, P. sabiniana, P. halepensis, Pseudotsuga macrocarpa, Cedrus deodara, and Libocedrus decurrens.

Fire damages a tree by killing or injuring the foliage, the buds, or the cambium. All three were considered in appraising damage to individual trees. It should be noted that little or no experience was available on which to base the assessment of fire injury to Coulter and knobcone pine in this survey. All of our experience to date in judging damage has been with ponderosa, Jeffrey, and sugar pine.

Survey Methods

The survey was conducted largely on a reconnaissance basis. Conditions in one natural stand of conifers damaged by the fire were observed only from a distance, but all eight of the plantings were visited and inspected. About a dozen or more trees were classified according to degree of fire injury in each plantation. This, plus a general reconnaissance of the plantation, provided the basis for estimating the percent of the residual trees expected to recover. Where the effects of the fire were variable within a plantation, areas having different intensities of damage were sketched on a map (see map attached).

The fire-injured trees in the plantings were classified into three groups based on their expected chance of recovery. Class 1 included trees which were given a very good chance of recovery. Class 2 included those where the chance of recovery was considered doubtful. Class 3 included those considered to have a very poor chance of recovery. In general, trees placed in Class 1 had very little bud injury, not more than moderate foliage damage, and little

cambium injury. Class 2 trees were those with moderate bud injury, moderate-to-heavy foliage injury, and moderate cambium injury. In Class 3 were placed the trees having more than 50 percent of the buds killed, heavy foliage damage, and more than 50 percent of the cambium killed or injured. Examples of trees placed in these different categories were marked with aluminum paint in the plantings near headquarters.

In order to arrive at an estimate of the number of trees likely to recover in each planting, the estimated number of trees per acre before the fire was multiplied by the area of the plantation in acres. The product was then multiplied by the percent expected to survive. For example, in plantation number 2, about 13.9 acres were so heavily burned that the expected survival was only 2 percent. In this same planting, 1.9 acres of moderate burn occurred where the expected survival was 20 percent. The estimated number of trees per acre before the fire was 375. Thus $375 \times 13.9 \times 0.02 = 104$; and $375 \times 1.9 \times 0.20 = 142$. Therefore, the total number of trees expected to recover in this plantation is 246. Since no precise information on the number of acres in each planting was readily available, estimates of the acreages were obtained from a map by D. M. Ilch prepared in 1937 titled "Location of Plantations." The areas shown on this map were measured with a planimeter.

Insect History

The planted trees, particularly Coulter and knobcone pine on the San Dimas Experimental Forest, have been subject to attack by the California five-spined engraver, Ips confusus (Lec.), for a number of years. Damage in the plantings around the headquarters at Tanbark Flat in the past has been restricted largely to knobcone pine, although a few Coulter pines also have been killed. Last year two knobcones and one Monterey pine were killed, and this year one large Coulter pine near the gasoline pump in plantation 3-4 and 10 additional Coulter pines in plantation 7 were infested. The western pine beetle, Dendroctonus brevicomis Lec., and the red turpentine beetle, D. valens Lec., have not been reported from the Experimental Forest, although these insects may be present. At Brown's Flat only about 2 1/4 miles away, where an island of natural ponderosa pine occurs, both these pests are present. There is a strong possibility that they would migrate into the plantings which have been seriously injured by fire. We know that both of these species cause serious damage to Coulter pine in other parts of southern California. The red turpentine beetle also causes damage to knobcone pine.

The trees in these plantings have been relatively thrifty, and since they are young they normally would not be apt to suffer from serious damage by bark beetles. However, now with so many fire-damaged trees present, the chances for the development of a destructive infestation are considerably greater than before. It is not unreasonable to expect that bark beetles may reach damaging proportions in the plantings unless corrective measures are taken.

Results

The survey results show that about 90 percent of all the planted trees in the eight plantations were killed or so badly injured by fire that their chances of survival are very poor. Of the 136 acres planted, an estimated 123 acres were burned over heavily, 9 acres moderately, and about 4 unburned.



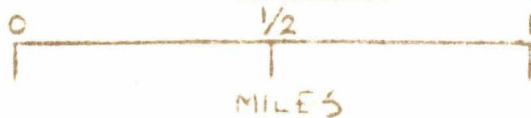
LOCATION OF PLANTATIONS

SAN DIMAS EXP. FOREST

FIRE DAMAGE

NONE =
MODERATE
HEAVY

SCALE



The estimate that about 10 percent of the trees will survive is predicated on the assumption that subsequent attack by primary insects can be prevented or greatly minimized. Conditions in the plantings in the Tanbark area and in the other outlying areas are discussed below. The data are summarized in Tables 1 and 2.

Tanbark Area

Plantations close to the Tanbark headquarters include 2, 3, 4, 5, and 6. These plantings altogether contain an estimated 47.3 acres. Most of this area (34.2 acres) was heavily burned, 9.3 acres were moderately burned, and 3.8 acres unburned. It is estimated that about 524 trees will survive in the heavy burn and 1,050 in the moderate burn. The unburned area contains an estimated 1,140 green, uninjured trees.

Plantation 2 is to the west of headquarters and north of the road coming in from the west. The tree species are largely Coulter pine, with a small amount of knobcone pine.

Plantations 3 and 4 are generally to the south from the headquarters area. The tree species here are largely Coulter pine, with some knobcone, big-cone Douglas-fir, and a few miscellaneous conifers present.

Plantation 5 is south and east of the Staff house. The tree species is mostly Coulter pine, but some knobcone, a few deodars, and some incense-cedars also are present.

Plantation 6 is to the north from the Staff house and east of the mess hall. The tree species is a mixture of Coulter and knobcone pines, with the former predominating.

Outlying Areas

In the outlying areas are included plantations 1, 7, and 8, totaling an estimated 78.5 acres. All of these were in a very heavy burn. It is estimated that only about 400 trees will survive in these plantings.

Plantation 1, which is in two parcels, was very heavily burned. The tree species here is predominately Coulter pine, with a few knobcone pines present.

Plantation 7 also is in two parcels and also was very heavily burned. The tree species is predominately Coulter pine, but a little knobcone pine is present.

Plantation 8, known as the Flintham Memorial Planting, was in a heavy burn. Most of the trees with a chance for survival are around the fringe on the south and west sides. The tree species here is Coulter pine.

Natural Areas

The natural area of ponderosa pine at Brown's Flat, which is also on the Experimental Forest, was not examined on the ground. The stand, reputed to be a small island of virgin ponderosa pine, was viewed from a distance of

Table 1.--Area, stocking, fire injury, and expected survival^{1/} in San Dimas Plantations

No.	Plantation name	Area Planted	Year planted	Intensity of burn	Heavy burn		Moderate burn		None		Total	
					Acres	Percent survival	Acres	Percent survival	Acres	Percent survival	Acres	Percent survival
		<u>Acres</u>										
1	South East	14.7	29-30	Uniformly heavy	14.7	1.0					14.7	1.0
	South West	21.6	29-30	" "	21.6	1.0					21.6	1.0
2	North	15.8	29-30	Variable	13.9	2.0	1.9	20.0			15.8	4.2
3-4	Exp.Plant.	10.9	30-31	Variable	7.9	2.0	3.0	30.0			10.9	9.7
5	Exp.Plant.	10.0	30-31	Variable	3.8	10.0	2.4	60.0	3.8	100.0	10.0	56.2
6	Exp.Plant.	10.6	31-32	Variable	8.6	10.0	2.0	20.0			10.6	11.9
7	Exp.Plant.	19.7	32-33	Uniformly heavy	19.7	1.0					19.7	1.0
8	Flintham	32.6	19	Uniformly heavy	32.6	8.0					32.6	8.0
Total		135.9			122.8	3.9	9.3	33.5	3.8	100.0	135.9	8.7

^{1/} Expressed as a percent of the original stand.

Table 2.--Number of trees expected to survive in San Dimas Plantations,
by fire injury classes

	:	Estimated	:	:	:	:	:	:	:	:
	:	original	:	Heavy	:	Moderate	:	No	:	:
Plantation	:	stand	:	burn	:	burn	:	burn	:	Total
Number		Trees per acre	Acres	Trees	Acres	Trees	Acres	Trees	Acres	Trees
1 SE		200	11.6	30					11.6	30
SW		200	19.4	40					19.4	40
2		375	10.4	100	1.9	140			12.3	240
3-4		400	7.9	60	3.0	360			10.9	420
5		300	3.8	114	2.4	430	3.8	1,140	10.0	1,684
6		300	8.6	250	2.0	120			10.6	370
7		200	14.9	40					14.9	40
8		120	32.6	310					32.6	310
Total		231	109.2	944	9.3	1,050	3.8	1,140	122.3	3,134

about a mile, from a ridge to the south. Smoke and haze conditions made visibility very poor and it is impossible to estimate the amount of damage to the stand. There appeared to be one large, faded, flat-topped tree in the eastern portion which could have been insect-killed, but this is only a surmise. This area should be inspected as soon as possible to determine the extent of damage from the fire and the extent of insect activity. Brown's Flat is currently accessible by a foot trail, but plans are underway to construct a jeep trail into the area as part of the mop-up program on the fire. We know that the fire covered the whole area but nothing is known about the intensity of the burn.

Discussion

It should be pointed out that the estimates included in this report are only approximate, and that the data listed for acreage, original trees per acre, and percent of trees likely to survive are subject to error. In order to determine what would be included in a control program, more precise surveys will be needed to delineate specific areas for treatment, and determine the actual number of trees involved.

The past history of Coulter pine injured by fire, in various parts of southern California, reveals that a rapid buildup of the western pine beetle, the red turpentine beetle, and the California five-spined ips can be expected. An upward trend in infestations of these bark beetles is apt to occur in the burned plantings on the San Dimas unless preventive measures are taken. Just what beetle infestations develop in knobcone pine injured by fire remains to be seen. The red turpentine beetle, the California five-spined ips, and the California flatheaded borer are the insects most likely to increase in this host.

Because young knobcone pine has thin bark, cambium injury was severe wherever the fire burned around the base of the trees. Coulter pine has a better chance of survival, because it has thicker bark which provides better protection to the cambium.

Fire-injured trees, which may be attacked and killed by insects, can be protected with insecticides.^{1/} The residual insecticides show a high potential as protective sprays for safeguarding trees from bark beetle attacks. They have a long residual life and a high contact toxicity. The danger from the beetles on the San Dimas Experimental Forest is greatest at the present time, for this is a period when most primary bark beetles and many secondary bark beetles and borers are in the adult stage seeking new hosts. Spraying done immediately should protect the trees for the remainder of the year. And it should not be necessary to respray them next year unless the beetle hazard is high.

Laboratory studies and small-scale, simulated field tests have shown both lindane and dieldrin to be especially effective residuals. Experience with lindane in other parts of the country as a protective spray has been particularly favorable. Either of the two chemicals would be especially worthy of trial as protective sprays at San Dimas.

^{1/} The discussion of insecticides in this section is based on material prepared by R. L. Lyon.

Formulation and cost data for a single treatment with either lindane or dieldrin follow. The extent to which both lindane and dieldrin are used remains to be determined.

Formulation: Water emulsion

Insecticide: Lindane or dieldrin

Concentration: 0.5 percent (based on active ingredient) or 4 lbs. actual/
100 gal. water.

Formula for mixing:

$$\frac{\text{Gallons spray wanted} \times \text{percent concentration wanted} \times 8.3}{\text{Pounds active ingredient in emulsion concentrate} \times 100} =$$

Gallons emulsion concentrate needed to make
volume of finished spray wanted.

Example: Where percent concentration wanted is 0.5 percent
active ingredient in emulsion concentrate is 1.7 pounds
volume finished spray wanted is 100 gallons

$$\frac{100 \times 0.5 \times 8.3}{1.7 \times 100} = 2.44$$

Amount of spray needed:

2 gal. mixed spray/100 sq. ft. bark surface
Average tree: 16" d.b.h. or 200 ft² bark surface
4 gal. spray/ave. tree
2,000 trees x 4 gal./tree = 8,000 gal. mixed spray needed

Estimated costs: (Based on 2,000 16-inch trees and 4 gal. mixed spray/tree.)

<u>Item</u>	<u>Unit Cost</u>	<u>Amount</u>	<u>Total Cost</u>
Insecticide concentrate ^{1/}	\$5.10/gal.	195 gal.	\$ 994.00
Labor ^{2/}	25.00/man day	60 man days	1500.00
Gasoline	0.30/gal.	50 gal.	15.00
Total			\$2509.00

Cost of emulsion concentrate roughly 60¢/tree

^{1/} Assuming 1.7 lb. actual/gal. emulsion concentrate.

^{2/} Based on 3 man-days/100 trees.

The above cost estimate covers only the requirements for protecting the trees in the San Dimas plantations. An additional \$1,000 may be needed to spray the trees at Brown's Flat. When costs for technical assistance, supervision and common services are added, the total cost of the program suggested is \$4,800.

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